SPAWAR Systems Center San Diego

Space and Naval Warfare Systems Center, San Diego (SSC San Diego)

ROBOTICS UPDATE

"Providing network-integrated robotic solutions for C4ISR applications."

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Annual Publications Supplement: 2004

"Eliminating the Operator Control Unit," Everett, H.R., Pacis, E.B., and Sights, B., Department of Defense Human Factors Engineering Technical Advisory Group Meeting 52, Alexandria, VA, November 3, 2004.

This is a viewgraph presentation that first addresses the issue of near-term standardization of the operator control unit for man-portable robots, and then looks at technology development efforts which support long-term elimination of the operator control unit altogether. The intent is to interface with the robots using the next-generation voice-over-IP systems the warfighters will use to communicate (voice, video, map displays) with each other.

"A Segway RMP-Based Robotic Transport System," Nguyen, H.G., Kogut, G., Barua, R., Burmeister, A., Pezeshkian, N., Powell, D., Farrington, N., Wimmer, M., Cicchetto, B., Heng, C., and Ramirez, V., SPIE Proc. 5609: Mobile Robots XVII, Philadelphia, PA, October 26-28, 2004.

A small robotic transport system based on the Segway Robotic Mobility Platform has been developed to perform autonomous following of a human leader. In the first demonstration, the transporter used a vision system running a continuously adaptive mean-shift filter to track and follow the human. In a second demonstration, the physical separation between leader and follower was significantly increased using GPS breadcrumbs.

"A Vision System for an Unmanned, Non-lethal Weapon," Kogut, G., and Drymon, L., SPIE Proc. 5608: Intelligent Robots and Computer Vision XXII, Philadelphia, PA, October 25-27, 2004.

Unattended weapons are difficult to control manually from a remote location. A computer vision system capable of detecting and tracking motion assists human operators in detecting and aiming at targets, allowing the operator to focus on target verification and situational awareness.

"Automated Launch, Recovery, and Refueling for Small Unmanned Aerial Vehicles," Mullens, K., Burmeister, A., Wills, M., Stroumtsos, N., Denewiler, T., Thomas, K., and Stancliff, S., SPIE Proc. 5609: Mobile Robots XVII, Philadelphia, PA, October 26-28, 2004.

This paper describes the development of a prototype system designed to autonomously launch, recover, refuel, and re-launch small (Class I/II) UAVs. This system is intended to provide forward-refueling capabilities by teaming small UAVs with large unmanned ground vehicles.

"Intelligent Behaviors for a Convoy of Indoor Mobile Robots Operating in Unknown Environments," Farrington, N., Nguyen, H.G., and Pezeshkian, N., SPIE Proc. 5609: Mobile Robots XVII, Philadelphia, PA, October 26-28, 2004.

Intelligent behaviors allow a convoy of small indoor robots to perform high-level mission tasking. These behaviors include various implementations of map building, localization, obstacle avoidance, object recognition, and navigation.

"Segway Robotic Mobility Platform," Nguyen, H.G., Morrell, J., Mullens, K., Burmeister, A., Miles, S., Farrington, N., Thomas, K., and Gage, D., SPIE Proc. 5609: Mobile Robots XVII, Philadelphia, PA, October 26-28, 2004.

The Segway Robotic Mobility Platform™ (RMP) is a new mobile robotic platform based on the self-balancing Segway Human Transporter (HT). This paper describes the history and development of the platform, its characteristics, and a summary of current research projects involving the platform at various institutions across the United States.

Annual Publications Supplement: 2004 *(continued)*

"Towards a Warfighter's Associate: Eliminating the Operator Control Unit," Everett, H.R., Pacis, E.B, Kogut, G., Farrington, N., and Khurana, S., SPIE Proc. 5609: Mobile Robots XVII, Philadelphia, PA, October 26-28, 2004.

Small man-portable robots like the Foster-Miller TALON and the iRobot PacBot have demonstrated their ability to assist on dangerous missions in theater such as chemical/radiological detection and the detection/neuralization of improvised explosive devices (IEDs), but their associated operator control units tend to interfere with the warfighter's mission effectiveness. This paper discusses efforts underway to significantly improve the autonomy and functionality of such robots, making them more of an asset, while reducing the burden of (and eventually eliminating) the operator control unit, making it less of a liability.

"Maintaining Communication Link for Tactical Ground Robots," Nguyen, H.G., Farrington, N., and Pezeshkian, N., AUVSI Unmanned Systems North America 2004, Anaheim, CA, August 3-5, 2004.

The communication link between a tactical mobile robot and its control station degrades quickly as the robot penetrates the interior of a building, tunnel, or cave, or is occluded by intervening structures. We have demonstrated a solution using autonomous mobile relay nodes, which convoy behind the main robot and automatically stop where needed to form an ad hoc network guaranteeing a link between the lead robot and the base station.

"Unmanned Ground Vehicles for Integrated Force Protection," Carroll, D., Mikell, K., and Denewiler, T., SPIE Proc. 5422: Unmanned Ground Vehicle Technology VI, Orlando, FL, April 13-15, 2004.

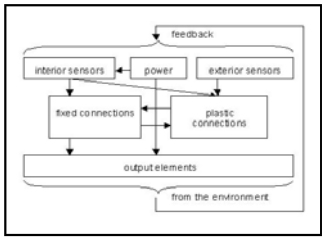
The combination of command and control (C2) systems with unmanned ground vehicles (UGVs) provides integrated force protection from the Robotic Operation Command Center. This paper presents an overview of the key technology enablers for integrated force protection, with details on a force-on-force scenario to test and demonstrate concept of operations using unmanned ground vehicles. Special attention is given to development and applications for the Remote Detection Challenge and Response (REDCAR) initiative for integrated base defense.

"Improved Mobility in a Multi-degree-of-Freedom Unmanned Ground Vehicle," Blackburn, M.R., Bailey, R., and Lytle, B., SPIE Proc. 5422: Unmanned Ground Vehicle Technology VI, Orlando, FL, April 13-15, 2004.

A robot of fixed dimensions will always be too big to get through some passageways, and too small to get over some obstacles. This paper describes a multi-degree-of-freedom unmanned ground vehicle (UGV) that can change its conformation and dimensions, and negotiate a greater range of environmental dimensionality than is possible for UGVs with just two or three degrees-of-freedom.

"Enhancing Functionality and Autonomy in Man-Portable Robots," Pacis, E.B., Everett, H.R., Farrington, N., and Bruemmer, D., SPIE Proc. 5422: Unmanned Ground Vehicle Technology VI, Orlando, FL, April 13-15, 2004.

Significant improvements in both functionality (i.e., perform more useful tasks) as well as autonomy (i.e., with less human intervention) are required to increase the level of general acceptance and hence the number of small man-portable robots deployed in support of the warfighter. This paper describes efforts to address these needs through a spiral development process that capitalizes on technology transfer to harvest results of prior and ongoing activities throughout the technical community.

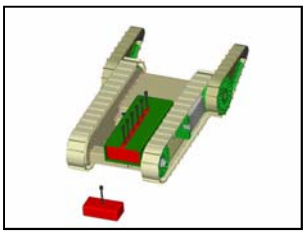


"Foundations for Learning and Adaptation in a Multidegree-of-Freedom Unmanned Ground Vehicle," Blackburn, M., and Bailey, R., SPIE Proc. 5421: Intelligent Computing: Theory and Applications II, Orlando, FL, April 12-13, 2004.

The real-time coordination and control of a many-motion degree-of-freedom unmanned ground vehicle under dynamic conditions in a complex environment is nearly impossible for a human operator to accomplish. This paper describes the control processes of a small unmanned ground vehicle with six degrees of freedom in the three spatial dimensions, based upon five fixed action patterns, and five adaptive reactive behaviors that motivate and protect the vehicle during operation through modulation of the fixed action pattern.

"Maintaining Communication Link for a Robot Operating in a Hazardous Environment," Nguyen, H.G., Pezeshkian, N., Gupta, A., and Farrington, N., ANS 10th Int. Conference on Robotics and Remote Systems for Hazardous Environments, Gainesville, FL, March 28-31, 2004.

We address the problem of maintaining a robust high-bandwidth RF communication link between a mobile robot and its remote control/monitoring station, using a number of autonomous mobile relay nodes. These slave robots convoy behind the lead robot and automatically stop where needed to maintain an ad hoc network that guarantees a link between the lead robot and its control station. Nodes that are no longer needed in the network have the ability to navigate back to the lead robot, in order to redeploy at a later time.



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